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| 14. ABSTRACT<br>This ASSERT project supported a graduate student, Ms. Lisa Eisner, to apply newly-developed, state-of-the-art bio-optical instrumentation to the analysis of phytoplankton processes in biological oceanography. Ms. Eisner obtained bio-optical data from a time-series of vertical profiles (2-3 cm vertical resolution) of hydrographic and bio-optical data from East Sound, Orcas Island, WA, and from continental shelf waters off Oregon. Ms. Eisner has examined patterns of occurrence of thin planktonic layers in association with distinct physical properties. In addition, she has used High Performance Liquid Chromatography (HPLC) to define the phytoplankton pigment signatures within these planktonic layers, and has related those HPLC data to the in situ absorption signatures of the phytoplankton assemblages. Her results suggest that <i>in situ</i> absorption measurements can be an index of photoadaptation by marine phytoplankton. This finding is significant because it can reduce the need to obtain discrete samples for pigment analysis during oceanographic experiments and it can provide rapid assessment of the physiological condition of marine phytoplankton assemblages. |             |                         |                            |  |   |
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## **Final Technical Report: Small-Scale Bio-Optical Distributions In The Upper Ocean (AASERT) (ONR Award # N00014-96-1-0933)**

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### **LONG-TERM GOALS**

The long-term research goal of my group is to quantify the interactions between small-scale biological and physical processes within the upper ocean. This project has addressed that goal by providing support for a graduate student to assist in field work, sample analysis, and data processing and analysis within the parent project "Assessing The Role Of Small-Scale Bio-Optical And Bio-Acoustical Distributions In Upper Ocean Biological And Optical Processes."

### **OBJECTIVES**

Our objective in this AASERT project has been to train graduate students to think critically about scientific questions, and to develop the skills to address well-formed questions with the appropriate analytical tools. This ASSERT project has supported Ms. Lisa Eisner, a graduate student in Biological Oceanography, to work with newly-developed, state-of-the-art bio-optical instrumentation, and has provided the opportunity for her to participate in the growth of an important new research area within biological oceanography.

### **APPROACH**

Ms. Eisner has been working with bio-optical data obtained from a time-series of high-resolution vertical profiles (2-3 cm vertical resolution) of hydrographic and bio-optical data from East Sound, Orcas Island, WA, and from the continental shelf waters off the Oregon coast. Ms. Eisner has examined, using data analysis software, patterns of occurrence of thin planktonic layers in association with distinct physical properties. In addition, she has used High Performance Liquid Chromatography (HPLC) to define the phytoplankton pigment signatures within these planktonic layers, and has related those HPLC data to the in situ absorption signatures of the phytoplankton assemblages.

### **WORK COMPLETED**

Ms. Eisner has completed her graduate coursework in oceanography and has passed to candidacy for the Ph.D. degree. She has become adept in the use of sophisticated data analysis approaches in dealing with our large data sets of high-resolution profiles of physical and bio-optical properties. She has participated in two cruises off the Oregon coast that focussed on the linkages

between small-scale bio-optical processes and physical processes. In addition, she participated in the 1998 Thin Layers experiment in East Sound, Orcas Island, WA. She has gained valuable experience with the high-resolution profiling system. She has presented results of her research at major scientific meetings, and has a manuscript in the final stages of preparation. She expects to defend her Ph.D. thesis within the next 18 months.

## RESULTS

Ms. Eisner has found a striking correlation between the pigment composition of a phytoplankton assemblage (as defined with HPLC) and the shape of the absorption spectrum (defined *in situ* with *in situ* absorption meters). Her results suggest that *in situ* absorption measurements can be used as an index to evaluate photoadaptation by marine phytoplankton. This finding has significance because it can reduce the need to obtain discrete samples for pigment analysis during oceanographic experiments and it can provide rapid assessment of the physiological condition of marine phytoplankton assemblages.

## SIGNIFICANCE

The work by Ms. Eisner on the extensive data set from East Sound Thin Layers Experiment provides new insights into the application of *in situ* instrumentation toward understanding the mechanisms that create that persistent pattern on small-scales. These insights will be essential for prediction of the impact of persistent small-scale pattern on the attenuation of optical and acoustic signals in the upper ocean. Ms. Eisner will be continuing to apply these approaches at oceanic study sites as we participate in the CoOP program and GLOBEC program off the coasts of northern California and Oregon during the next few years.

## PRESENTATIONS

- 1999 Eisner, Lisa B., M. S. Twardowski, T.J. Cowles. Phytoplankton pigment composition in relation to finescale optical properties in East Sound, Orcas Island, WA. 1999 Aquatic Sciences Meeting, Santa Fe, NM., February 1999.
- 2000 Eisner, Lisa B., M. S. Twardowski, T.J. Cowles. *In situ* spectral absorption (ac-9) measurements as an index of photoprotective/photosynthetic carotenoid ratios. 2000 Ocean Optics Meeting, Monaco, October 2000.

## MANUSCRIPTS

- Eisner, Lisa B., M. S. Twardowski, T.J. Cowles. Phytoplankton pigment composition and *in situ* spectral absorption measurements in East Sound, Orcas Island, WA. To be submitted to *Limnology and Oceanography*, December 2000.